APPENDIX I

AIRFIELD CONE PENETROMETER

The airfield cone penetrometer is a probe-type instrument that gives an index of soil strength. It uses a 30-degree, right circular cone with a base diameter of 1/2 inch and an indicator that gives a reading directly in terms of an AI.

The AI then can be used to estimate a CBR value, as shown in FIgure I-1, page 1-2. This correlation has been established to yield values of CBR that generally are conservative. The tendency towards conservatism is necessary because there is no unique relationship between these measurements and a wide range of soil types. The curve should not be used to estimate AI values from the CBR determination because these generally would not be conservative.

BASIC SET

The airfield cone penetrometer must not be confused with the trafficability penetrometer, which is a standard military item included in the soil test set. If the trafficability penetrometer is used to measure the AI, the reading obtained with the 0.2-square-inch cone must be divided by 20, and the readings obtained with the 0.5-square-inch cone must be divided by 50.

The airfield cone penetrometer comes with a carrying case that is 14 3/4 inches long and houses the cone unit and a handle that screws off the base. Two 12 5/8-inch extensions are graduated every 2 inches. and two 11/32-inch wrenches are used to tighten the set in assembly. An extra cone and an extra pin for the handle are also included.

The airfield cone penetrometer is constructed of durable metals and needs little care other than cleaning and oiling. The calibration should be checked occasionally. The load indicator should read *O* when the instrument is suspended by the handle and 15 when a 150-pound load is placed on the handle. If an error of more than 5 percent is noted, the penetrometer should be recalibrated.

The airfield cone penetrometer does well when used in silt or clay. In gravel the readings are meaningless, and the AI is determined for the soil beneath the gravel layer.

Sands require special treatment. Many sands occur in a loose state. When very dry, sands show increasing AIs with depth, but the 2-inch depth index is often low—about AI 3 or 4. Sands can usually support aircraft with requirements much higher than AI 3 or 4 because the strength of the sand increases under the confining action of the aircraft tires. Generally, dry sand or gravel is adequate for aircraft in the C- 130 class, regardless of the penetrometer readings. Avoid sands and gravel in a *quick* condition (water percolating through them). Evaluation of moist sands should be determined by the same method as used for a fine soil.

Because soil conditions are immediately and significantly affected by weather, an evaluation is valid only for the period immediately after measurements are made. However, the evaluation will remain constant as long as the soil moisture content does not change.

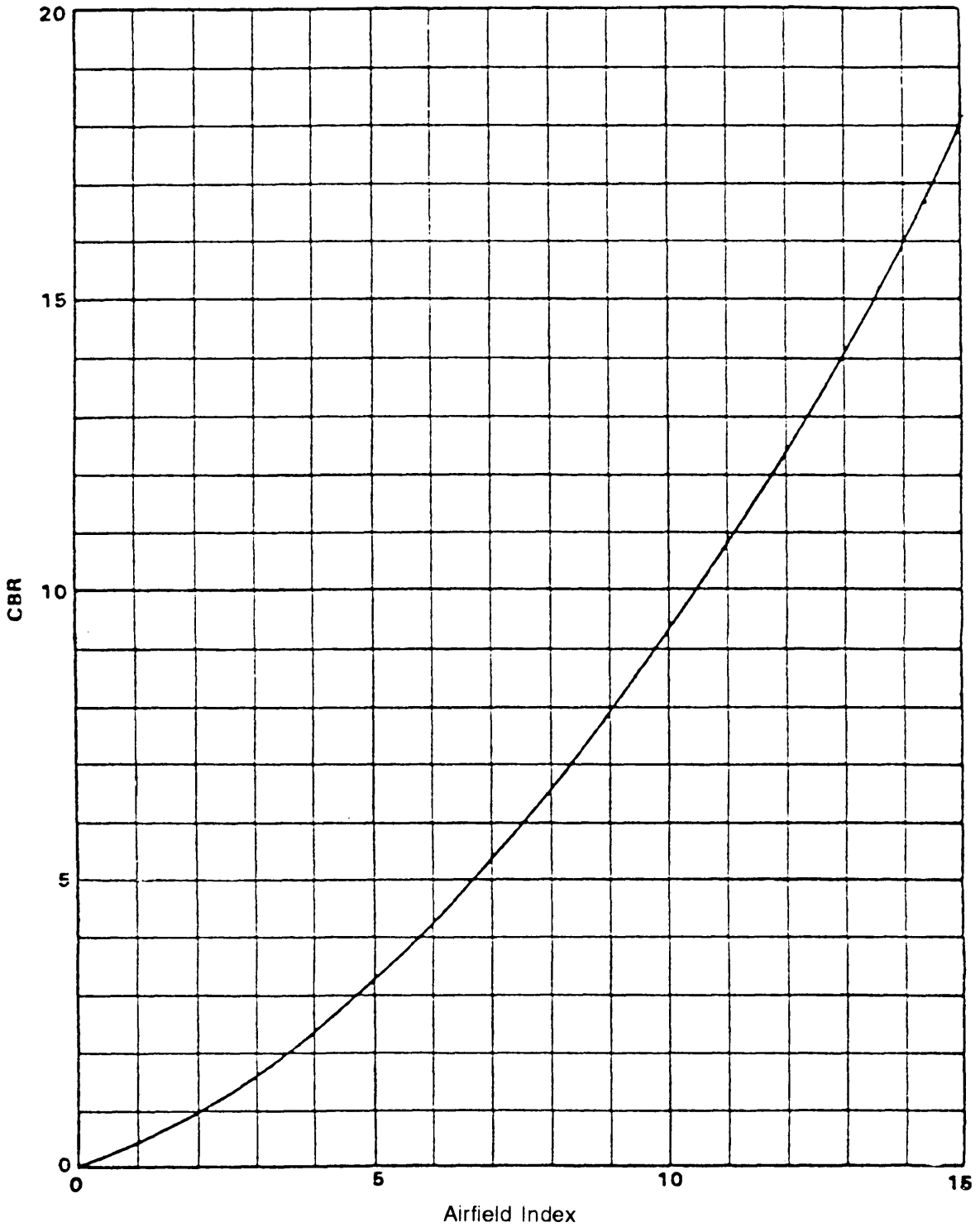

Figure I-1. Correlation of CBR and AI

I-2 *Airfield Cone Penetrometer*

ASSEMBLY AND OPERATION OF AN AIRFIELD PENETROMETER

To assemble an airfield penetrometer, detach the handle and cone from the housing, attach the staff extension to the housing, and attach the cone to the staff extension. Insert the handle to the top of the housing and tighten the extension using an 11/32-inch wrench. Be careful not to overtighten because excessive force can bend or break the shafts.

Use the following procedures to operate an airfield penetrometer:

1. Inspect for tightness and ensure the handle, cone, and extension are properly attached.

2. Place the penetrometer in a vertical posi tion on the soil, and place hands in a vertical position on the handle.

3. Slowly apply force at a rate of 1/2 inch to 1 inch per second, and penetrate the soil. Take readings at 2-inch increments, up to 24 inches or until a maximum AI (15) is obtained. Discard the 0-inch reading. Record readings in tabular fashion for the engineer's use similar to the sample format shown in Figure I-2, page I-4.

If you suspect the cone is encountering stone or other foreign body at the depth where a reading is desired, make another penetration nearby.

Take five penetrations at each location, using an X configuration in a 12-inch radius circle. Note the readings at each 2-inch increment. Once an AI (15) has been reached, the follow-on depths can be assigned an AI (15) after the following criteria have been satisfied:

A minimum of three sites must be tested to ensure the lower depth has an AI 15 or higher. These tests should be taken at least every 6 inches down to the 24-inch depth or lower for the heaviest C-130 landing and highest pass levels if very low (4) AI values are suggested to exist below the 24-inch depths. An auger may be used to penetrate to the desired depth. At a minimum, one reading must be taken on the turnarounds, the parking apron, and off center on the runway.

If a suspected abnormal layer is present, take enough readings to the 24-inch layer to verify the extent of the area. Since this is the most critical area, the entire atrfield must be evaluated based on the abnormal layer.

4. After the readings at a site have been taken, the readings for each depth at the site are averaged. The critical depth is then determined, and the critical AI is determined by averaging the average readings in the critical depth. After all critical AIs are determined for all sites, the lowest critical AI is assigned for the entire airfield.

5. Determine the surface thickness requirements as described in Chapter 12.

DETERMINATION OF CRITICAL AI RUNWAYS AND TAXI WAYS

1. The first reading will be taken 50 feet from one end of the runway/taxiway on the centerline.

2. Follow-on readings will be read every 200 feet and will be staggered 20 feet off the centerline. This means that if the second reading is 20 feet right of the centerline, the third reading will be 20 feet left of the centerline, and so on.

3. This pattern will be repeated until the midpoint is reached. After the midpoint, the survey team will go to the other end of the runway/taxiway, start the readings 50 feet on center from that end, and repeat the survey pattern back to the midpoint (Figure I-3, page I-5).

PARKING APRONS

1. Locate the center of the area and take the first set of readings.

2. Take the rest of the readings every 200 feet in both directions until the extent of the area has been covered (Figure I-3).

SOIL STRENGTH EVALUATION
AIRFIELD INDEX (AI)

AIRFIELD: DATE:
LOCATION:

DEPTH	AIRFIELD INDEX	SUM	AVG

CRITICAL DEPTH:

CRITICAL AI:

COMMENTS:

Figure I-2. Sample format for AI data sheet

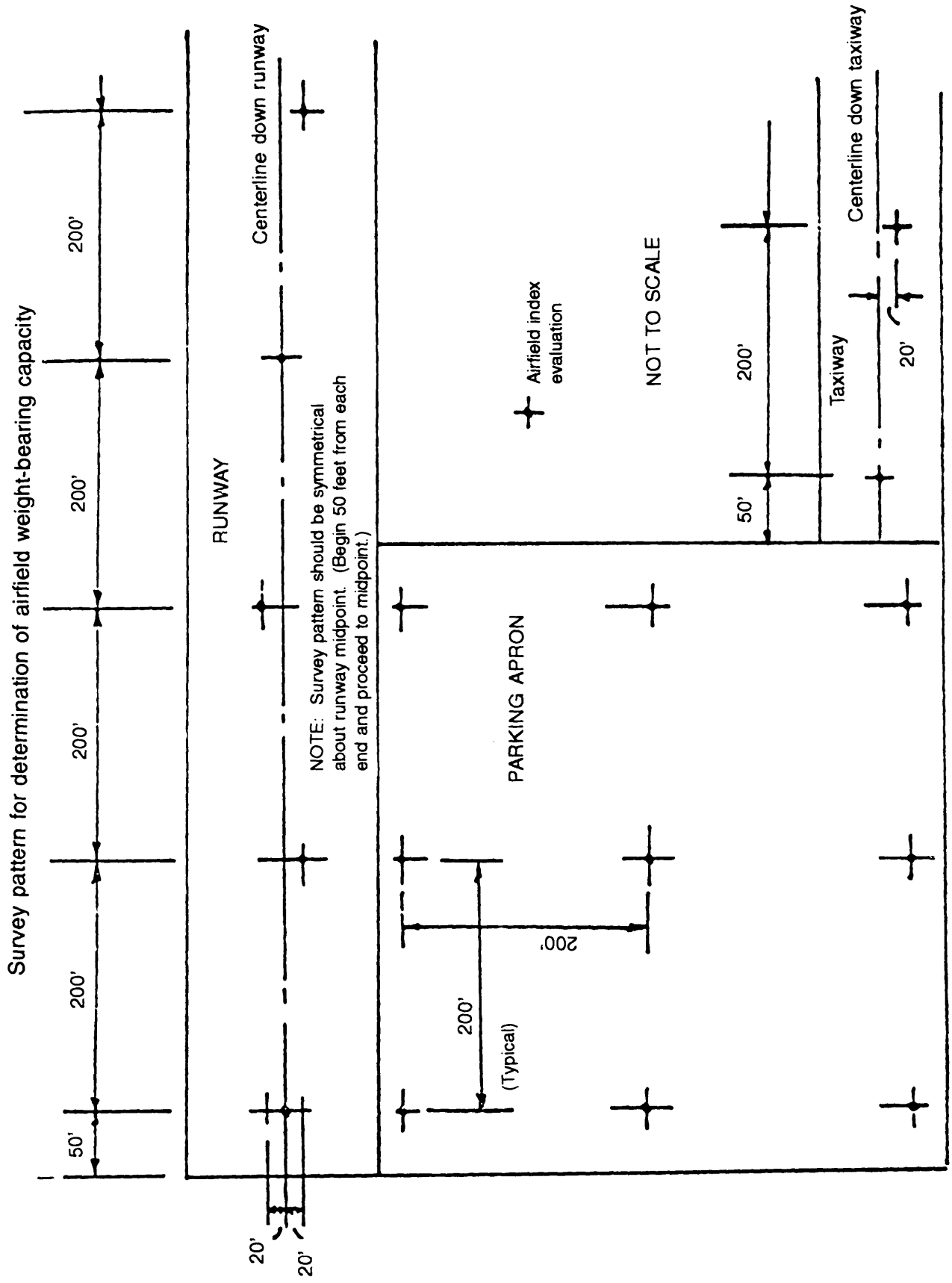

Figure I-3. Survey pattern for taxiways and parking apron

HAMMERHEAD TURNAROUNDS

1. Locate the enter area and take the set of readings.

2. Take the rest of the readings 40 feet in both directions until the extent of the area has been covered (Figure 1-4). A minimum of one reading at the parking apron, runway, and hammerhead must be taken to the 24-inch depth to ensure the soil profile is accurate. If a soft layer is suspected or located beneath a hard, upper layer, take enough readings down to the 24-inch depth to ensure complete and accurate coverage of the area.

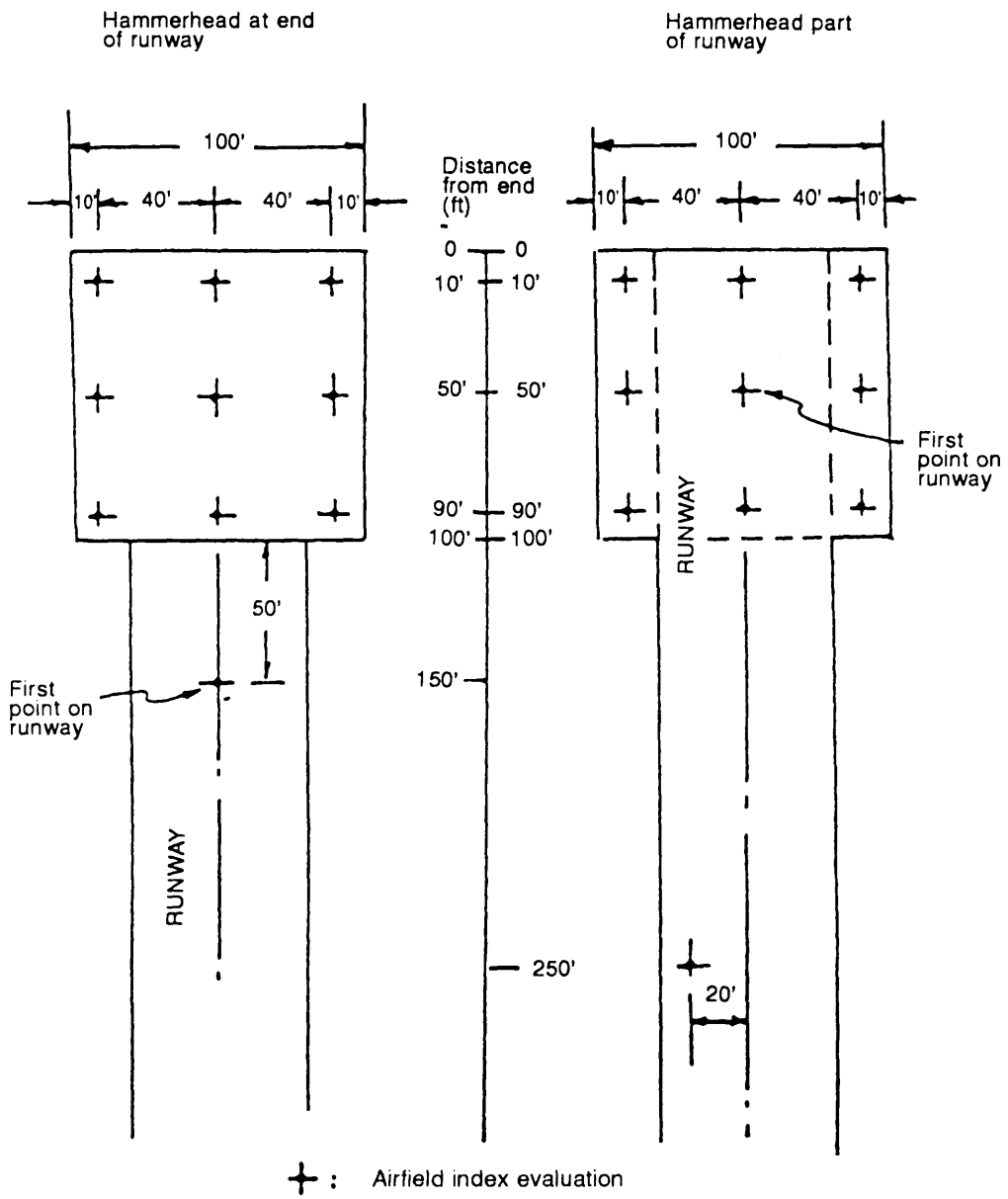

Figure I-4. Survey pattern for hammerhead turnarounds